GENETICS AND BREEDING

Reproductive Traits in Culled Native Cows from Three Herds in Huambo Province, Angola

Carlos Javier de Loyola Oriyés, Isaias Cachicolo Gila**, Efigénia Singa Cassule Camela*, Manuel Francisco Simão*, Marlin García Sorrondegui**** and *Fernando Maia**

***José Eduardo dos Santos University, Faculty of Veterinary Medicine, Department of Animal Production, Province of Huambo, Angola**

****Veterinary medicine student, José Eduardo dos Santos University, Faculty of Veterinary Medicine, Province of Huambo, Angola**

***** Epandi Farm, Province of Huambo, Angola**

cloriyes51@gmail.com

ABSTRACT

A reproductive characterization of culled native cows was performed to three herds in Huambo province, Angola. The study made in June revealed that 54 of all the cows evaluated (331) in the three herds were culled animals (24, 17, and 3 per herd, respectively). Age, body condition (BC), total calving (TC), and calving interval (CI) were determined. General descriptive statistics was performed, and the factor studied was the herd. Age was distributed normally and the herds were compared through ANOVA, and Tukey for multiple comparison of means. The other variables (BC, TC, and CI) were evaluated through the Krustall Wallis method and U-Mann-Whitney statistics. The general age mean was 8.15±1.80, and the medians for BC, TC, and CI were, 2.5, 3.0, and 730.0, respectively. Overall, the results were distant from the optimal values of reproduction. The BC ($P < 0.05$), TC, ($P < 0.01$), and CI ($P < 0.01$) were significantly influenced by the herd. Regardless of the herd effect, the poor utilization of the productive potential was caused by early culling, with insufficient excessively prolonged TC and CI periods, in addition to nutritional problems expressed in low BC.

Key words: *culling age, total calving, calving interval, body condition, culled cows*

INTRODUCTION

Cow longevity and culling are two of the most critical issues in cattle breeding research today (Adamczyk, Zaborski, Grzesiak, Makulska, and Jagusiak, 2016). Longevity traits and useful life are, for their part, two reliable indicators to determine animal management and wellbeing (Adamczyk, Makulska, Jagusiak, and Węglarz, 2017). The performance features of a cow's mean lifespan are duration of productive life, number of lactations, average days of lactation, and mean productivity in certain periods of time (Adamczyk *et al.*, 2017).

Longevity refers to the period that a cow remains in the herd, which considering their biological potential, today´s dairy cows have a short productive time (Alvåsen, Dohoo, Roth, and Emanuelson, 2018). Moreover, culling refers to the cows removed from the main herd, usually due to different voluntary or forced reasons (Tatar, Deniz Şireli, & Tutkun, 2017).

In recent years, longevity and culling have created concern within the international scientific community and farmers, particularly in highly developed cattle raising countries. In Africa, few reports have been made about this issue, as in Morocco (Boujenane, 2017) in the north, and in Sub Central AfricaNfor *et al.* (2014).

Nyamushamba, Mapiye, Tada, Halimani, and Muchenje (2017) reported that cattle production in southern Africa is performed extensively in small stables, with original beef cattle lines predominantly, which are adaptable to the local environment. The native cows from Angola are predominant in cattle raising areas. No reports about proper use of their potential during their reproductive life have been made so far, though this is important to improve production yields. Hence, the aim of this research was to conduct a reproductive characterization of native culled cows in three herds of the province of Huambo, Angola.

MATERIALS AND METHODS

This research was done in June, 2018, province of Huambo, Angola, Farmland No. 24, Plan Alto Central, 1 750-1 800 m above sea level. A clinical-gynecological test was performed to all the native cows in the three herds (Table 1), according to the methodology described by Holý (1987).

Table 1. Distribution of cows per herd

Herds	Total cows	Total culled cows
1	123	24
2	119	17
3	89	13
Total	331	54

These herds were under extensive raising, fed native grass (*Hiparremia rufa* herds No. 1 and 3, and *Braquiaria bisantia* herd No.2). Water was administered *ad libitum* in all cases. The local climate is favorable in terms of temperature throughout the year (the annual means of maximum temperatures vary between 25 °C and 27 °C (higher values in the rainy season), and minimum temperature means between 11 °C and 13 °C (lower values in the dry season). However, the values of precipitations underwent a marked seasonality, the rainy season starts in September and ends in April, with an annual mean that varies between 1 100 and 1 400 mm.

Due to the absence of individual records, the age of animals was determined by chronology of dental incisives described by Luengo, Aros, and Gómez (1990); whereas the TC was determined by the rings in the horns, based on the methodology described by Álvarez *et al.* (2005); BC was determined by the five-point scale (1=thin, 5=fat), with 0.25 increments (Edmonson, Lean, Weaver, Farver, and Webster, 1989), considering the double purpose of this kind of cattle; and CI was estimated by this formula,

CI = [(A-2) x 365 days] / TC

Where: CI: Calving interval

A: Age

2: The constant assumed after estimating the beginning of reproduction at two years of age, maximum.

TC: Total calving: 365 days of the year

The response variables were age, BC, TC, CI, whereas herd was the study factor. The general statgraphics were calculated (minimum, maximum, medium, and typical deviation). The Shapiro-Wilk test was performed to determine the existence of normal distribution of the variables that met that condition. Variance homogeneity (Levene test) was analyzed by one-way ANOVA; the Tukey's test was used for multiple comparisons of the means. The unequally distributed variables were evaluated by the Kruskal Wallis test. The Mann-Whitney test was performed to determine the differences between average ranges. SPSS (2006) was used for statistical analysis.

RESULTS AND DISCUSSION

The culling age barely surpassed 8 years in only three calvings (Table 2), when it could have achieved between 5 and 6 years, according to Álvarez *et al.* (2005). This is the CI outcome for almost three years.

Table 2. General descriptive statistics of age, BC, TC, and CI

	N	Minimum	Maximum	Mean	Median	Typical Dev.
Age	54	5	13	8.15	8.0	1.8
Body condition	54	1.50	3.25	2.39	2.5	.48
Calvings	54	1	7	2.85	3.0	1.22
CI	54	456.25	2 555.00	905.55	730.0	426.60
N. valid (according to the list)	54					

The culling age is variable, Alvåsen *et al.* (2018) referred to a mean culling age of 5.04 years in Sweden; 5.9 in Morocco (Boujenane, 2017); 6 years in Italy, according to Gallo, Sturaro, and Bittante (2017); 9.18 years in Cuba, according to (Bertot Valdés *et al.*, 2001); and 6.4 years in the Sub Central African Region, according to Nfor *et al.* (2014). The younger the culling age, the greater the need to select replacement females with ideal aptitudes, which is costly. (Mohd Nor, Steeneveld, Mourits, and Hogeveen, 2015). Although Roberts, Petersen, and Funston (2015) said that culling before five years causes a negative impact on efficiency.

In many cases, the common practice to ensure herd survival when the replacement is not ready is to keep the oldest animals (Roberts *et al.*, 2015) with ensuing low productive capacity. Hence, it is important to reduce the intensity of selection (Pandey, Singh, and Barwal, 2016) to cut down costs. This decision will have to be taken by farmers, as demonstrated by McCabe, Prendiville, Evans, O'Connell, and McHugh (2018).

Furthermore, Bertot Valdés *et al.* (2001) reported a CI of 1 810.22 days in Cuba, and 3.94 total calving mean (approximately one more calving, but in dairy herds) of culled females. Although BC was not determined, the mean daily gain was evaluated. Significant economic and productive losses can occur when the selection of healthy replacements takes over 13 months (Álvarez *et al.*, 2005).

Increased dental wearing with age (Luengo *et al.*, 1990) and cyclical gestation-lactation have a negative effect on the BC of cows at the time of sacrifice, even more than in males (de Souza Guimarães, Camisão de Souza, de Andrade, Fonseca de Freitas and Cirillo, 2008; Nfor *et al.*, 2014; Shittu, Zaharadeen, Fasina, Umaru, and Ahmed, 2014; D'Andre Hirwa *et al.*, 2017), which are particularly marked under extensive grazing.

The sale of culled cows to slaughter houses is a major source of income, though an aspect that decides their quality and price is BC (Shittu *et al.*, 2014; Gallo *et al.*, 2017), which is influenced by the herd, management, nutrition, and the lapse between the last calving and sacrifice. BC increases even beyond 400 days after the last calving before culling, according to reports of Gallo *et al.* (2017), but these results were achieved under intensive production; hence, a related study would be invaluable to extensive production systems that abound in Angola.

The ideal BC for selling and adequate carcass quality is within the mid scoring. However, in Africa, the BC of sacrifice cows is low (Shittu *et al.*, 2014), with a similar trend in the cattle studied, which is negative in terms of economic and carcass yields.

Compton *et al.* (2017), in a meta-analytical study, demonstrated that the increase in the mortality and culling rates was originated by the intensification of production for 25 years (1989-2014). However, the three herds studied were fed grass under extensive production. The associated wearing owed to the availability of foods, which was more striking in the particular dry seasons of the region.

Age was distributed normally (P>0.05, according to Shapiro Wilk), and it showed variance homogeneity among the groups (P=0.055, according to Levene). However, the herd effect for this variable was not significant (Table 3).

Table 3. Mean comparisons of the age of culled native cows from the three herds (Tukey's HDS)

Herds	N	Subset for alpha=.05
		1
Herd 3	13	7.31
Herd 2	17	7.94
Herd 1	24	8.75
Sig.		.052

The rest of the response variables showed significant differences among the herds (Tables 4 and 5).

Table 4. Results of the Kruskall Wallis test for the herd effect on BC, TC, and CI

Kruskal-Wallis	Average ranges		
	BC	TC	CI

Chi-square	8.28	12.06	7.699
gl	2	2	2
Sig. asintot.	0.016	0.002	0.021

Table 5. Results of herd comparison according to the Mann-Whitney test for BC, TC, and CI

Variable	Herds	N	Average range	U Mann-Whitney	Wilcoxon W	Z	P
BC	Herd 1	24	25.08	106.00	259.00	-2.91	0.004
	Herd 2	17	15.24				
	Herd 1	24	20.35	73.00	164.00	-2.85	0.004
	Herd 3	13	16.50				
	Herd 2	17	16.24	98.00	189.00	-0.57	0.571
	Herd 3	13	14.54				
TC	Herd 1	24	17.10	110.50	410.50	-2.49	0.013
	Herd 2	17	26.50				
	Herd 1	24	16.31	91.50	391.50	-2.06	0.039
	Herd 3	13	23.96				
	Herd 2	17	15.68	107.50	198.50	-0.13	0.899
	Herd 3	13	15.27				
CI	Herd 1	24	17.10	110.50	410.50	-2.49	0.013
	Herd 2	17	26.50				
	Herd 1	24	16.31	91.50	391.50	-2.06	0.039
	Herd 3	13	23.96				
	Herd 2	17	15.68	107.50	198.50	-0.13	0.899
	Herd 3	13	15.27				

The similarity between herds in terms of culling age may be the result of undesired consensus among farmers to decide the best moment to sell or sacrifice a culled cow, despite its low yields, probably due to the absence of records or insufficient individual and herd data. Related research conducted in intensive production herds is facilitated by comprehensive controls and accessibility. In Africa, sometimes, access to data is hidden by cattle farmers (Shittu *et al.*, 2014).

Proper records will allow timely CI and TC, thus helping culled unproductive females, and improving mass selection, which has been demonstrated by Alvåsen *et al.* (2018) and McCabe *et al.* (2018), but with the support of large institutional databases.

Besides, the reasonable time of BC recovery up to mid-score (around 3) after the last calving, should be the indicator defining the exact moment of selling or sacrificing a culled female, in order to reach the best selling prices and optimize revenues (Gallo *et al.*, 2017).

Also outstanding, the differences among herds are well documented in the scientific literature. In that sense, Armengol and Fraile (2018) concluded that the causes of rejection may be significantly different among dairy farms, even under similar production systems, health status, close veterinary diagnostic source, and software to compile herd data. These differences may occur mainly due to farmer personality, differences in cow management, and easiness of design.

Beyond these herd contrasts, the values achieved indicated poor use of the productive potential of bovine females with the biological capacity to produce offspring every 12-13 months regularly (Álvarez *et al.*, 2005), and 12-14 calvings in their reproductive lifespan, under optimum living standards available in grass-based systems.

Conclusions

Regardless of the herd effect, generally, the poor utilization of the reproductive potential led to low BC due to premature culling of still useful cows, in terms of reproduction, and with insufficient instances of prolonged TC and CI, in addition to nutritional problems.

Recommendations

The authors recommend BC evaluation during the time elapsed between the last calving and the time of sale or sacrifice, under the extensive production conditions of Angola. Moreover, it is important to implement control systems that allow measuring, controlling, and proper decision making to improve the situation of culled females in Angolan cattle herds.

Acknowledgments

We wish to thank the owners of Epandi, Ninho, and Sampaio Farms. Our appreciation to the Faculty of Veterinary Medicine, José Eduardo dos Santos University (FMV-UJES).

References

ADAMCZYK, K.; MAKULSKA, J.; JAGUSIAK, W. y WĘGLARZ, A. (2017). Associations Between Strain, Herd Size, Age at First Calving, Culling Reason and Lifetime Performance Characteristics in Holstein-Friesian cows. *Animal, 11* (2), 327-334.

ADAMCZYK, K.; ZABORSKI, D.; GRZESIAK, W.; MAKULSKA, J. y JAGUSIAK, W. (2016). Recognition of Culling Reasons in Polish Dairy Cows using Data Mining Methods. *Computers and Electronics in Agriculture, 127* (1), 26-37.

ÁLVAREZ, J. L.; MARTÍNEZ, G.; MONTES, I.; ORTA, S.; PLANAS, M. T.; PUENTES, T., *et al.* (2005). *Cría vacuna. Tecnologías para aumentar la eficiencia reproductiva* (2da ed.). La Habana, Cuba: Sociedad Cubana de Criadores de Ganado de Carne y Doble Propósito (SOCCA).

ALVÅSEN, K.; DOHOO, I.; ROTH, A. y EMANUELSON, U. (2018). Farm characteristics and management routines related to cow longevity: a survey among Swedish dairy farmers. *Acta Vet Scand, 60* (38), 1-11.

ARMENGOL, R. y FRAILE, L. (2018). Descriptive Study for Culling and Mortality in Five High-Producing Spanish Dairy Cattle Farms (2006-2016). *Acta Vet Scand, 60* (45), 1-11.

BERTOT, J. A.; DÍAZ, Y.; AVILÉS, R.; VÁZQUEZ, R.; ALVAREZ, J. L.; GARAY, M., *et al.* (2001). Factores que influyen en la duración de la vida reproductiva útil en rebaños bovinos de la provincia de Camagüey, Cuba. *Rev. prod. anim., 13* (2), 77-80.

BOUJENANE, I. (2017). Reasons and Risk Factors for Culling of Holstein Dairy Cows in Morocco. *Journal of Livestock Science and Technologies, 5* (1), 25-31.

COMPTON, W. R.; HEUER, C.; THOMSEN, P. T.; CARPENTE, T. E.; PHYN, V. C. y MCDOUGALL, S. (2017). Invited Review: A Systematic Literature Review and Meta-Analysis of Mortality and Culling in Dairy Cattle. *J. Dairy Sci., 100* (1), 1-16.

D'ANDRE, C.; RUGIRA, D.; MUREKEZI, T.; DAMASCENE, J.; KAYITESI, A.; MUSEMAKWERI, A., *et al.* (2017). Management and Phenotypic Features of Indigenous Cattle in Rwanda. *International Journal of Livestock Production, 8* (7), 95-112.

DE SOUZA, A.; CAMISÃO, J.; DE ANDRADE, I. F.; FONSECA, R. T. y CIRILLO, M. Â. (2008). Characterization of Cattle Slaughtered at the Public Abattoir in Lavras-MG. *Ciênc. agrotec., 32* (1), 251-257.

EDMONSON, A. J.; LEAN, I. J.; WEAVER, L. D.; FARVER, T. y WEBSTER, G. (1989). A Body Condition Scoring Chart for Holstein Dairy Cows. *J. Dairy Sci., 72* (1), 68-78.

GALLO, L.; STURARO, E. y BITTANTE, G. (2017). Body Traits, Carcass Characteristics and Price of Cull Cows as Affected by Farm Type, Breed, Age and Calving to Culling Interval. *Animal, 11* (4), 696-704.

HOLÝ, L. (1987). *Biología de la reproducción bovina*. La Habana, Cuba: Editorial Científico Técnica.

LUENGO, L. J.; AROS, I. C. y GÓMEZ, R. L. (1990). Determinación de la edad del bovino según las características morfológicas de los dientes incisivos. Contribución a la aplicación de la norma chilena 1423 Of. 84. Terminología y clasificación. *Avances de Medicina Veterinaria, 5* (1), 14-20.

MCCABE, S.; PRENDIVILLE, R.; EVANS, R.; O'CONNELL, N. E. y MCHUGH, N. (2018). Effect of Cow Replacement Strategy on Cow and Calf Performance in the Beef Herd. *Animal, 2* (1), 1-9.

MOHD, N.; STEENEVELD, W.; MOURITS, C. M. y HOGEVEEN, H. (2015). The Optimal Number of Heifer Calves to be Reared as Dairy Replacements. *J. Dairy Sci., 98* (1), 1-11.

NFOR, B. M.; CORAZZIN, M.; FONTEH, F. A.; AZIWO, N. T.; GALEOTTI, M. y PIASENTIER, E. (2014). Quality and Safety of Beef Produced in Central African. *Italian Journal of Animal Science, 13* (3), 392-397.

NYAMUSHAMBA, G. B.; MAPIYE, C.; TADA, O.; HALIMANI, T. E. y MUCHENJE, V. (2017). Conservation of Indigenous Cattle Genetic Resources in Southern Africa's Smallholder Areas: Turning Threats Into Opportunities. A review. *Asian-Australas J. Anim Sci., 30* (5), 603-621.

PANDEY, S.; SINGH, C. V. y BARWAL, R. S. (2016). Selective Value, Quantification and Genetic Parameters of Components of Replacement Traits in Crossbred Cattle. *Vet. Med. Open J., 1* (1), 1-5.

ROBERTS, A. J.; PETERSEN, K. y FUNSTON, R. N. (2015). Can We Build the Cow Herd by Increasing Longevity of Females? *J. Anim. Sci., 93* (1), 4235-4243.

SHITTU, A.; ZAHARADEEN, M. M.; FASINA, F. O.; UMARU, M. A. y AHMED, A. (2014). Classification of Slaughtered Animals and Estimation of Body Condition Scores During Rainy Season in Sokoto Abattoir. *Sokoto Journal of Veterinary Sciences*, *12* (2), 31-40.

SPSS (2006). SPSS 15.0 para Windows (Versión 15.0.1).

TATAR, A. M.; DENIZ, H. y TUTKUN, M. (2017). Reasons for Culling and Replacement Rate in Dairy Cattle. *Animal Science, 60* (1), 49-51.

.

Received: 9-10-2018
Accepted: 9-16-2018